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(12) UK Patent Application (19) GB (11) 2 041 178 A

(21) Application No 8003159
(22) Date of filing
30 Jan 1980
(30) Priority data
(31) 79/03173
(32) 30 Jan 1979
(33) United Kingdom (GB)
(43) Application published
3 Sep 1980
(51) INT CL³ F41H 5/00
1/00
(52) Domestic classification
F3C PK
(56) Documents cited
GB 1453873
(58) Field of search
F3X
(71) Applicant
Michael Sacks
43 Woodhall Avenue
Whitefield
Manchester
(72) Inventor
Michael Sacks
(74) Agents
Sydney E. M'Caw & Co

(54) **Protective screen**

(57) The effects of explosion of a bomb or other explosive device or material can be reduced or contained by positioning a protective screen around such device or material. The screen is in the form of an open-ended tube or sleeve having blast-resisting strengthening material (4) applied to its side walls. The blast-resisting strengthening material may comprise multiple layers of a material such as a woven aramid fabric. The sleeve may have a lid (8) which is blown off during the explosion. The open upper end of the sleeve directs the blast safety in a non-destructive direction and the sleeve may accordingly be curved. Preferably the sleeve diverges upwardly so that the blast tends to keep it on the ground.

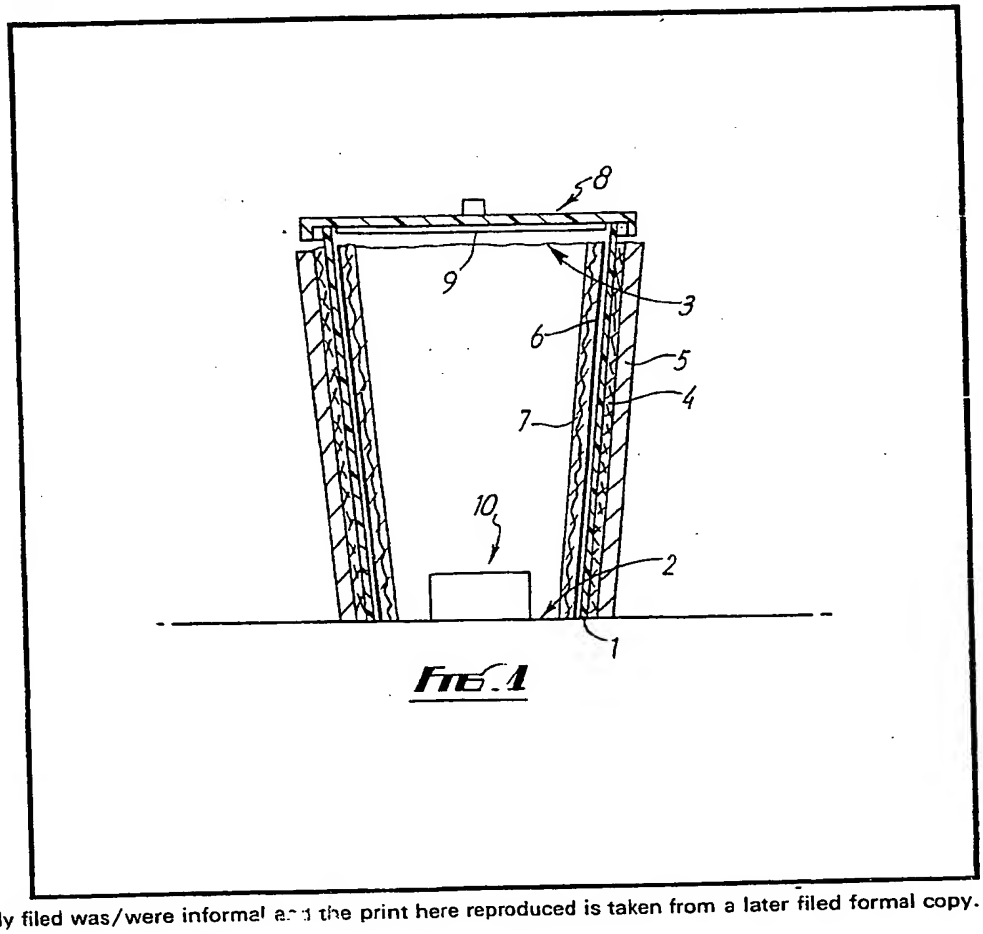

FIG. 1

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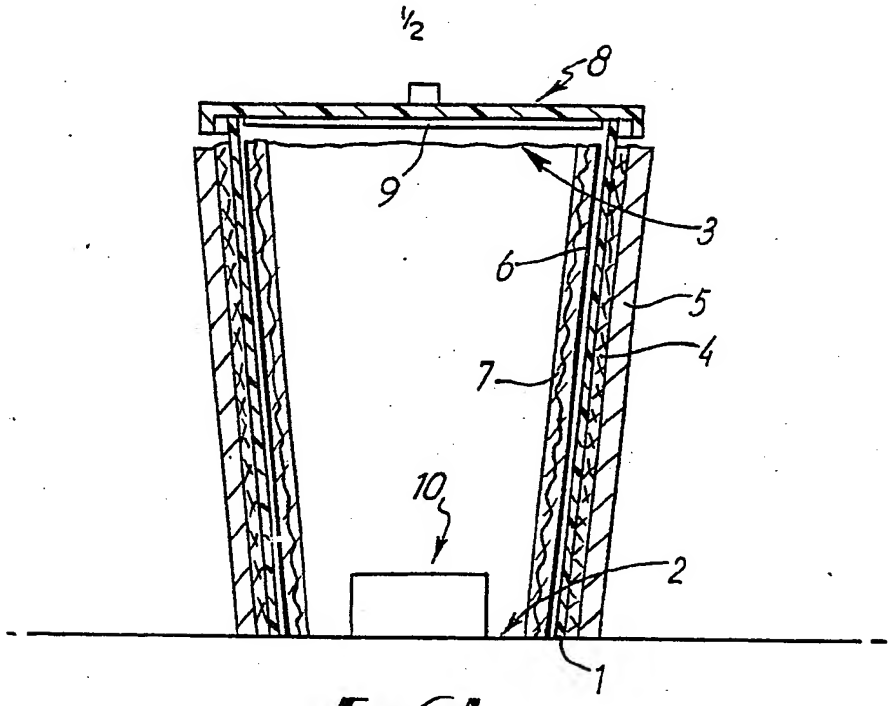

FIG.1

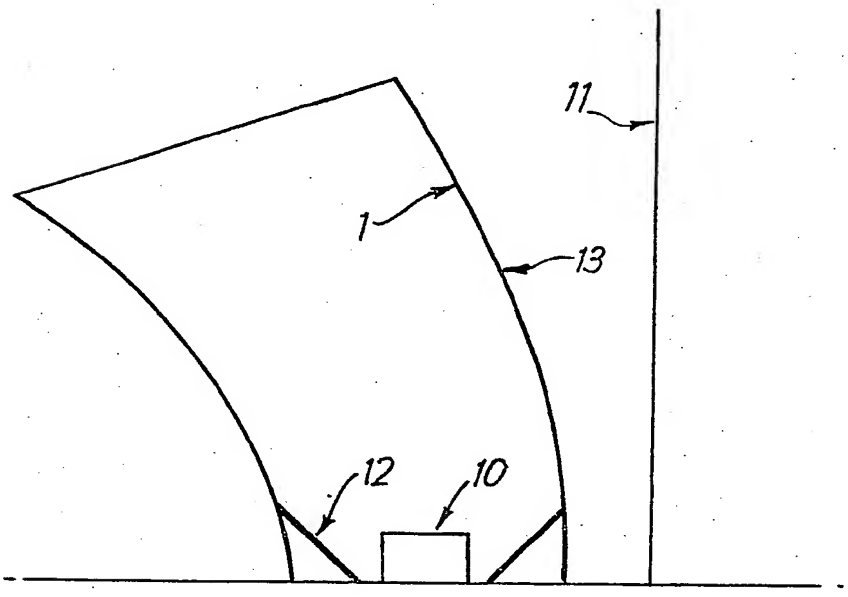

FIG.2

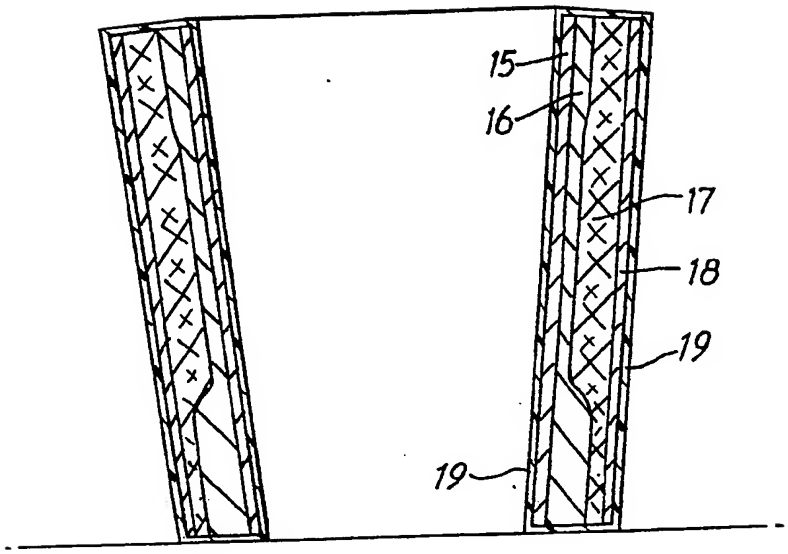

FIG.3

SPECIFICATION

Protective screen

This invention relates to protective screens for use with explosive devices to reduce or contain the effects of explosion thereof.

In the case where a bomb or other explosive device is found in a potentially dangerous situation it is desirable to be able to provide some protection against the effects of explosion thereof, at least on a temporary basis until the device can be deactivated or removed to a safer location, and an object of the present invention is to provide a method whereby such protection can be obtained in a quick and convenient manner.

According to one aspect of the invention therefore there is provided a method of protecting against the effects of explosion of an explosive device, said method comprising positioning a screen around the explosive device, which screen comprises a structure in the form of a tube or sleeve having blast-resisting strengthening material applied to the side walls thereof, said structure being open at one end to fit over such explosive device at such end and also being open or being readily openable at the opposite end whereby blast from an explosion occurring within the structure adjacent said one end can be channelled along the structure to escape from the said opposite end.

With this arrangement, in the case where an unexploded bomb is discovered on a ground surface in a potentially dangerous situation, for example in a populated area or close to a damageable structure or store of inflammable or explosive material or the like, protection can be afforded in a quick and convenient manner simply by manoeuvring the open end of the tubular or sleeve-shaped structure of the screen over the bomb until the screen is in a position at which it stands on the ground surface around the bomb and the bomb is contained within the screen adjacent the said one end of the said structure. In this position, in the event that the bomb does explode, the blast therefrom can be channelled along the tubular or sleeve-shaped structure to the said opposite end whereby the effects of the blast on surrounding personnel, structures or materials can be reduced.

Also, it will be appreciated that the protective screen can be positioned as aforesaid in a particularly simple manner and with the minimum of risk since the screen is simply placed on the ground surface around the bomb and there need be no physical contact with the bomb. Similarly, in the event that the bomb does not explode and attempts are to be made to deactivate or move same, access to the bomb for this purpose can be obtained in a quick, convenient and safe manner simply by lifting the screen off the ground surface away from the bomb.

Whilst reference is made above to use of the screen with bombs it is to be understood that the screen may also be used with other explosive devices or materials. Also, whilst reference is made to the positioning of the screen on a ground surface it is to be understood that the screen may also be used in other positions and/or on other surfaces.

With regard to the said structure of the screen, preferably, and in accordance with a second aspect of the present invention, this comprises a tube or sleeve which is open at one end and open or readily openable at the opposite end thereof, said tube or sleeve having multiple layers of a blast-resisting strengthening material applied to the side walls thereof. Preferably the tube or sleeve is of circular cross-section. Also the tube or sleeve may be formed from any suitable material or combination of materials including rubber, plastics, concrete, metal. The blast-resisting strengthening material may be capable of providing blast-resistance due to its blast deflecting properties and/or due to its ability to absorb blast due to deformation or disintegration thereof. The blast-resisting strengthening material may be a self-supporting rigid or semi-rigid material in which case the requisite structural properties of the tube or sleeve may be derived from such material. Alternatively or additionally a rigid or semi-rigid support may be provided, for example formed from plastics material, an open-work metal framework or the like. In accordance with a further additional or alternative possibility, requisite structural rigidity may be derived from additional impact or energy absorbing materials (as hereinafter described) and/or from the lamination of such additional materials with the blast-resisting material.

With regard to the said blast-resisting strengthening material, this preferably comprises a high strength material of strip or sheet form, most preferably yarns or a fabric formed from fibres of high tensile strength and high stretch resistance, particularly a fabric woven from aramid fibres of the kind sold by Du Pont under the Trade name KEVLAR. It is however also possible to use other strengthening materials, such as steel cords or the like additionally or alternatively to such fabric.

As already mentioned, in addition to said strengthening material other materials may be used for example having impact or energy absorbing properties. Thus layers of foam plastics material, strong flexible plastics sheeting (for example polycarbonate sheeting), rubber, steel plates or sheets, felted aramid fibres and the like may be incorporated as layers separate to or combined with the said strengthening material.

The strengthening material and/or the aforesaid additional material may be distributed uniformly around the tube or sleeve or, if

desired, may be non-uniformly distributed for example to give greater blast absorbence or deflection at one side. Such non-uniform distribution may be particularly important in the case where the screen is to be positioned non-symmetrically with regard to the location of the explosive device and/or with regard to the vertical axis through same. In this latter respect it will be appreciated that the positioning of the explosive device may be such that it is not desirable for blast therefrom to be channelled in a direct vertical direction, it being desirable instead to channel the blast at an angle to the vertical, and in this case it may be desirable to position the screen with the longitudinal axis of the tube or sleeve appropriately inclined to the vertical. To facilitate such positioning the said one end of the tube or sleeve may be appropriately inclined and/or the body of the screen may be inclined or curved away from said one end.

In addition to said strengthening material and any said additional material the screen may incorporate an appropriate material for purposes of screening against radio wave transmissions, thereby providing some protection against deliberate or inadvertent remote activation of a radio-controlled bomb. Said screening material may comprise a layer of metal foil applied to the inner surface of the structure or otherwise incorporated in the screen. Alternatively any other suitable material may be incorporated in any other suitable manner. To improve the radio screening effect a terminal or lead connected to the screening material may be provided for connection to an adjacent earth point. Also, a lid consisting of or incorporating screening material may be provided for the said opposite end of the tube or sleeve, said lid being easily removable so as not to unduly restrict blast escape from said opposite end.

With regard to the shape of the said tube or sleeve, this may be selected such as to facilitate channelling of blast to the said opposite end and/or such as to ensure that the action of the blast holds the screen securely in position around the explosive device. Thus, the screen may be divergent upwardly at least along part of its length. Similarly flutings or corrugations and/or other appropriately shaped surfaces or projections may be provided along the inner surface of the screen.

Also, for the purpose of ensuring that the screen is held in position around the explosive device, it is possible to provide weights, or anchoring devices such as stakes or the like preferably any such holding devices should be readily removable to enable the screen to be lifted as and when required to give access to the explosive device.

The screen may be moved into and/or out of position around the explosive device manually or by means of appropriate mechanical lifting devices which may be mounted on the back end of a vehicle or on a remote controlled robot or mechanical handling device. Thus, where appropriate, the screen is preferably of relatively low weight.

The invention will now be described further by way of example only and with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic sectional view of one form of a protective screen according to the invention;

Figure 2 is a similar view of a modified form of the screen; and

Figure 3 is a similar view of an alternative embodiment.

With reference to Fig. 1, the protective screen comprises a self-supporting tubular structure 1 formed from rubber or plastics material or the like. The structure is of upwardly divergent frusto-conical form and has open bottom and top ends 2, 3.

Around the outer surface of the structure 1 there are wrapped multiple layers of fabric 4 woven from Kevlar. Such fabric may be held in position by binding with wires or otherwise. Around the outer surface of such fabric 4 there is secured a layer or layers 5 of an energy absorbing material such as foam plastics and/or polycarbonate sheets. Around the inner surface of the structure there is secured a thin layer of metal foil 6 and a relatively thick layer 7 of felted Kevlar.

A lid 8 is provided which fits loosely over the open top end 3 of the structure 1, such lid being formed from the same material as the structure 1 and also having a layer of metal foil 9 on its inner surface.

The screen so far described is light and can be easily lifted and manoeuvred by hand, and appropriately positioned handles (not shown) may be provided on the structure for this purpose. Alternatively or additionally devices for attachment of mechanical lifting gear or the like may be provided.

In use, in the event that an unexploded bomb 10 is discovered on a ground surface, the screen is lowered into position around the bomb 10 until the lower open end 2 of the structure rests on the ground surface as shown in the drawings.

The screen may subsequently be lifted slightly or removed to provide access to the bomb for bomb disposal experts. It will be appreciated that positioning of the screen and subsequent lifting of same can be effected in a simple, convenient and quick manner without disturbing or contacting the bomb.

When the screen is in position, the metal foil 6, 9 forms a radiation screen to prevent deliberate or inadvertent actuation of a radio-controlled bomb. The lid 8 acts to prevent objects, rain or the like falling into the screen onto the bomb.

In the event that the bomb 10 explodes with the screen in position, the blast will be channelled vertically upwards to escape

through the top end 3 of the structure, the lid 8 being easily displaceable to permit this. The upwardly divergent shape of the structure 1 facilitates upward blast channelling and also gives rise to the production of a resultant downwards force on the structure 1 thereby to hold same in position on the ground. The Kevlar layers 4 give great strength and prevent easy destruction of the structure 1. The inner layer 7 acts to prevent penetration of the screen by shrapnel, and such layer 7 together with the outer layers 5 act to absorb and spread impact energy.

Fig. 2 shows a modified version which may be used, for example, alongside the wall 11 of a tank of inflammable or explosive liquid or gas. The screen has a structure which is shaped to direct blast at an angle to the vertical and away from such tank.

The structure also has a sharply inwardly divergent lower section 12 which gives a large downwardly acting anchoring force. Additional layers of strengthening and/or energy absorbing materials may be provided on the side 13 adjacent the tank wall 11 since a major portion of the blast may be directed at such side.

Fig. 3 shows an alternative embodiment which is formed in the following manner.

A sheet of energy absorbing polycarbonate material 5 is wrapped around a frusto-conical rigid former (not shown), and the edges of the sheet are bonded together so that such sheet adopts and maintains the peripheral shape of the former.

Multiple layers of woven Kevlar fabric 16 are then wrapped around the polycarbonate sheet. Twenty five layers of fabric are used although if desired further layers may be incorporated in the region of the top and bottom ends to give a total of say 50 layers of fabric at the top end and 100 layers at the bottom end.

A thick layer 17 of felted aramid fibrous material is wrapped around the Kevlar fabric 16 and around this there is wrapped a further polycarbonate sheet 18, the edges of such sheet 18 being bonded together like the sheet 15.

The former is then removed and the layers 15–18 are enclosed in a weatherproof plastics casing 19 which may be of a flexible or semi-rigid nature.

The resulting assembly constitutes a rigid or semi-rigid self-supporting frusto-conical tube or sleeve and this can be used in like manner to the screens of Figs. 1 and 2.

It is of course to be understood that the invention is not intended to be restricted to the details of the above embodiments which are described by way of example only. Thus, for example, in the case where a lower level of protection is required, it is possible to omit some or all of the additional protective layers of the above described embodiments whereby for example the screen may consist effectively only of the supported Kevlar fabric.

Further, where the screen is to be used with a bomb which is against a wall, the screen may have a cutout in one side extending from the lower periphery thereof. With this arrangement, the screen can be placed against the wall with the cut-out straddling the bomb thereby enabling the screen to fit around the bomb despite its proximity to the wall.

Reference is made to prior Patent 1,556,245 for a more detailed description of materials suitable for use in the present invention including Kevlar fabric, polycarbonate sheeting and foam plastics material as mentioned herein.

CLAIMS

1. A method of protecting against the effects of explosion of an explosive device, said method comprising positioning a screen around the explosive device, which screen comprises a structure in the form of a tube or sleeve having blast-resisting strengthening material applied to the side walls thereof, said structure being open at one end to fit over such explosive device at such end and also being open or being readily openable at the opposite end whereby blast from an explosion occurring within the structure adjacent said one end can be channelled along the structure to escape from the said opposite end.

2. A screen for use in the method of claim 1, comprising a tube or sleeve which is open at one end or readily openable at the opposite end thereof, said tube or sleeve having multiple layers of blast-resisting strengthening material applied to the side walls thereof.

3. A screen according to claim 2, wherein the tube or sleeve is of circular cross-section.

4. A screen according to claim 2 or 3, wherein the blast-resisting material is applied to a rigid or semi-rigid support.

5. A screen according to any one of claims 2 to 4, wherein the blast-resisting material comprises a high tensile strength fabric or strip of sheet form.

6. A screen according to claim 5, wherein the fabric is formed from aramid fibres.

7. A screen according to any one of claims 2 to 6, wherein said tube or sleeve also incorporates one or more additional layers of a material or materials having impact or energy absorbing properties.

8. A screen according to claim 7, wherein an additional layer of strong flexible impact absorbing polycarbonate sheet is incorporated.

9. A screen according to claim 7 or 8, wherein an additional layer of felted aramid fibres is incorporated.

10. A screen according to any one claims 2 to 9, wherein there are more layers of said blast-resisting material adjacent the said one end of the tube or sleeve than in the central region thereof.

11. A screen according to any one of claims 2 to 10, wherein the tube or sleeve is upwardly divergent away from the said one end thereof.

12. A screen substantially as hereinbefore described with reference to and as illustrated in Fig. 1 of the accompanying drawings.

13. A screen substantially as hereinbefore described with reference to and as illustrated in Fig. 2 of the accompanying drawings.

14. A screen substantially as hereinbefore described with reference to and as illustrated in Fig. 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.